Results from Analysis of KamLAND 4pi soaks

Sample	LS mass[g]	Sample mass[g]	Counting time [days]	^{210}Pb [cpd]	^{226}Ra [cpd]	^{40}K [mBq]	^{208}Tl [mBq]	^{212}Pb [mBq]	^{214}Pb [mBq]	^{214}Bi [mBq]	^{228}Ac [mBq]
Nylon mono-filament cable part	71.129	0.0722	6.9613	3.23±1.55	0.934±1.36	2.14±1.13	0.21±0.17	0.19±0.13	0.47±0.39	0.39±0.10	0.37±0.90
Titanium	77.869	5.415	12.034	4.90±1.13	2.12±1.05	1.40±0.73	0.10±0.11	0.08±0.10	0.30±0.27	0.29±0.75	0.44±0.67
Stainless Steel Cable Part	76.4	3.7167	6.0605	1.57±1.50	-0.50±1.43	4.10±1.26	0.11±0.16	0.18±0.14	0.88±0.43	0.29±1.06	0.08±0.94
Teflon Conductor	71.679	0.8051	5.8095	1.55±1.56	0.95±1.61	2.39±1.08	0.21±0.18	0.11±0.13	0.50±0.46	1.34±1.32	-0.61±0.93
Connector (motors, possible transducers)	79.889	25.3037	6.1776	0.89±1.47	2.10±1.47	1.12±1.03	0.23±0.20	0.22±0.14	0.47±0.39	0.56±1.15	-0.31±0.87
Blank	78.6	----	5.6637	5.65±1.61	-0.53±1.45	1.92±1.07	0.24±0.17	-0.03±0.14	0.44±0.21	0.63±1.19	-0.19±0.87
Second Soak in Sept.											
Blank (1 - 4)	67.1	----	15.6225	1.15±0.96	1.18±0.99	23.5±7.1	1.3±0.5	0.6±0.9	20.2±1.7	20.1±2.8	4.8±2.0
Cable with Red wire	65.5	11.3	5.3521	3.18±1.62	-0.65±1.54	39.0±13.3	1.9±0.1	2.6±1.4	7.4±2.0	0.5±2.0	6.9±3.2

Procedure for calculating the rates

The results shown here were calculated using the following method. Let N be the number of counts in the channels corresponding to 3 sigma around the mean energy of the gamma line. Then we take a region to the left and to the right of this region corresponding to (3 sigma)/2 channels respectively. The number of events corresponding to the area under the peak is then $N' = N - (N_L+N_R)$.

Do to the number of visible peaks being small in each of the spectra, regions of interest were defined using the energy calibration of the runs and the gamma peaks corresponding to the isotopes of interest. The following gamma lines were used in the evaluation of the associated activities.

- ^{210}Pb 46.539 keV
- ^{40}K 1460.83 keV
- ^{208}Tl 2614.53 keV 583.191 keV
- ^{212}Pb 238.63 keV
- ^{214}Pb 351.932 keV 295.224 keV
- ^{226}Ra 186.211 keV
- ^{214}Bi 609.312 keV 1120.287 keV 1764.494 keV
- ^{228}Ac 911.204 keV 968.971 keV 338.3220 keV

The efficiency calibration provided by Christopher was fit for the ln (E). This efficiency was determined by using mine water which provides us with gamma peaks for ^{214}Pb and ^{214}Bi that are then scaled to a known activity for the ^{40}K gamma line. The ^{40}K gamma line is found by measuring the mass of KCl salt which was added to the mine water. The known concentration of natural K in the salt leads us to a ^{40}K concentration via the known natural abundance of ^{40}K. Due to the efficiency being fit to a ln(E) value, this is not a sufficient efficiency calibration for determination of activities for mean energies below 200 keV. This is due to the 241.997 keV gamma line of ^{214}Pb being the lowest energy used in the calibration.

One may question the use of the 238.63 keV ^{212}Pb line being used for analysis due to the fit of the efficiency calibration by a point of higher energy. Due to the efficiency calibration of ln(E) being used, the actual efficiency for this gamma energy would tend to be higher than its actual value. In the activity calculation we take A= N/e*b, where e = efficiency and b = branching ratio of the gamma. Thus, a larger efficiency would underestimate the actual activity of the sample. However, in comparing this to a fit to the low background Ge detector at Alabama, this ln(E) fit has overestimated the actual efficiency by less than 1%. This is negligible compared to the current statistical error quoted above.

If it seems desirable to quantify the rates in terms of an absolute activity for energies below 200keV then a calibration of the detector efficiency for this geometry should be performed. There is also no systematic error known and this could be calculated fairly accurately with a calibration source.